CLAIMS

We claim:

1. A method for forming an ohmic contact on a semiconductor layer comprising:

(a) depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer; and

(b) depositing a refractory layer comprising electrically conductive material on the reactive layer, wherein said refractory layer is substantially free of gold.

2. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, InAs, $In_xGa_{1-x}P$, InP, $In_xAl_{1-x}As$, InGaAsP, GaSb, or $In_xGa_{1-x}Sb$, all wherein $0<x<1$.

3. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein $0.05<x<1.00$.

4. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein $0.3<x<0.8$.

5. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein x is approximately 0.6.

6. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer comprising electrically conductive material on at least a portion of a compound semiconductor layer that comprises InAs.

7. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a thin reactive layer comprising platinum, palladium, indium, nickel, ruthenium, vanadium, gold, cobalt or mixtures or composites thereof.

8. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a thin reactive layer comprising nickel.

9. The method according to claim 2 wherein said step of depositing a reactive layer comprises depositing a thin reactive layer further comprising an adhesive element.

10. The method according to claim 4 wherein said step of depositing a reactive layer comprises depositing a thin reactive layer further comprising an adhesive element selected from the group consisting of chromium, titanium, and silicon.

11. The method according to claim 4 wherein said step of depositing a reactive layer comprises depositing a thin reactive layer further comprising from about 5 to about 45 atomic percent of an adhesive element.

12. The method according to claim 1 wherein said step of depositing a refractory layer on the reactive layer comprises depositing a refractory layer comprising material selected from the group comprising titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicides and metal borides.

13. The method according to claim 1 wherein said step of depositing a refractory layer on the reactive layer comprises depositing a refractory layer comprising titanium.

14. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer having a thickness in the range of about 10 to about 500 angstroms.

15. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer having a thickness in the range of about 20 to about 100 angstroms.

16. The method according to claim 1 wherein said step of depositing a reactive layer comprises depositing a reactive layer having a thickness of about 40 angstroms.

17. The method according to claim 1 wherein said step of depositing a refractory layer on the reactive layer comprises depositing a refractory layer having a thickness of at least about 100 angstroms.

18. The method according to claim 1 wherein said step of depositing a refractory layer on the reactive layer comprises depositing a refractory layer having a thickness of about 800 angstroms.

19. The method according to claim 1 wherein said step of depositing a reactive layer is performed using at least one of the following techniques: evaporation, reactive sputtering, nonreactive sputtering, chemical vapor deposition, electroplating and electroless plating.

20. The method according to claim 1 wherein said step of depositing a refractory layer is performed using at least one of the following techniques: evaporation, reactive sputtering, nonreactive sputtering, chemical vapor deposition, electroplating and electroless plating.

21. An ohmic contact to a compound semiconductor layer comprising:

(a) a reactive layer; and

(b) a refractory layer, wherein said refractory layer is substantially free of gold.

22. The ohmic contact according to claim 21 wherein said reactive layer comprises platinum, palladium, indium, nickel, ruthenium, vanadium, gold, cobalt or mixtures or composites thereof.

23. The ohmic contact according to claim 21 wherein said reactive layer comprises nickel.

24. The ohmic contact according to claim 21 wherein said reactive layer further comprises an adhesive element.

25. The ohmic contact according to claim 24 wherein said adhesive element is selected from the group consisting of chromium, titanium, and silicon.

26. The ohmic contact according to claim 21 said reactive layer further comprises from about 5 to about 45 atomic percent of an adhesive element.

Sub D5

27. The ohmic contact according to claim 21 wherein said refractory layer comprises a material selected from the group comprising titanium, molybdenum, tungsten, TiW, metal nitrides, metal silicides and metal borides.

28. The ohmic contact according to claim 21 wherein said refractory layer comprises titanium.

Sub D6

29. The ohmic contact according to claim 21 wherein said reactive layer has a thickness in the range of about 10 to about 500 angstroms.

30. The ohmic contact according to claim 21 wherein said reactive layer has a thickness in the range of about 20 to about 100 angstroms.

31. The ohmic contact according to claim 21 wherein said reactive layer has a thickness of about 40 angstroms.

Sub D7

32. The ohmic contact according to claim 21 wherein said refractory layer has a thickness of at least about 100 angstroms.

33. The ohmic contact according to claim 21 wherein said refractory layer has a thickness of about 800 angstroms.

34. An ohmic contact to a compound semiconductor layer comprising:

(a) a reactive layer, said reactive layer comprising nickel and having a thickness of from about 10 to about 500 angstroms; and

(b) a refractory layer, said refractory layer comprising titanium and having a thickness of at least about 100 angstroms,

wherein said refractory layer is substantially free of gold.

35. The ohmic contact according to claim 34 wherein said reactive layer further comprises from about 5 to about 45 atomic percent of an adhesive element.

36. A method for forming an ohmic contact on a compound semiconductor layer of a semiconductor device comprising:

(a) depositing a reactive layer comprising nickel on at least a portion of a compound semiconductor layer of a semiconductor device, said reactive layer having a thickness of from about 10 to about 500 angstroms; and

(b) depositing a refractory layer on said reactive layer, said refractory layer comprising titanium and having a thickness of at least about 100 angstroms,

wherein said refractory layer is substantially free of gold.

37. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, InAs, $In_xGa_{1-x}P$, InP, $In_xAl_{1-x}As$, InGaAsP, GaSb, or $In_xGa_{1-x}Sb$, all wherein $0<x<1$.

38. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein $0.05<x<1.00$.

39. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein $0.3<x<0.8$.

40. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer on at least a portion of a compound semiconductor layer that comprises $In_xGa_{1-x}As$, wherein x is approximately 0.6.

41. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer on at least a portion of a compound semiconductor layer that comprises InAs.

42. The method according to claim 36 wherein said step of depositing a reactive layer comprises depositing a reactive layer further comprising from about 5 to about 45 atomic percent of an adhesive element.

43. An ohmic contact to a compound semiconductor layer of a semiconductor device made by the method of claim 1.

44. An ohmic contact to a compound semiconductor layer of a semiconductor device made by the method of claim 36.

Sub Dep7

Add C6

Add C5